


# REPORT DOCUMENTATION PAGE

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**To:** Dr. Robert J. Barker, Air Force Office of Scientific Research

**From:** Prof. Min-Chang Lee

**Date:** February 8, 1996

**Subject:** Final Report on "EM Wave Propagation & Attenuation in Magnetoplasmas"  
(F49620-92-J-0103)

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The AFOSR grant F49629-92-J-0103 had been used to support primarily a Ph.D. student, Daniel T. Moriarty for research on EM wave propagation and interaction with the magnetized plasmas generated in the Versatile Toroidal Facility (VTF). This grant together with in-house funds from MIT has made the operation of VTF possible to support several graduate students (including Dan Moriarty) and UROP (Undergraduate Research Opportunity Program) students for thesis research.

Dan Moriarty plans to finish his Ph.D. Dissertation in late May, and he expects to graduate this June. After this AFOSR grant expired on November 30, 1995, he has been supported by other funds arranged at the Institute. A copy of his Dissertation will be submitted to the AFOSR as a supplemental report when it becomes available.

The VTF has been used to investigate ionospheric plasma turbulence (and effects on radio waves, the so-called plasma cloaking) and cross-checking the plasma heating experiments at Arecibo, Puerto Rico. The first three attached figures are the radar-measured spectra of RF-excited Langmuir waves at Arecibo. These spectra of Langmuir waves were generated by RF pump waves at the frequencies of 5.1 MHz, 7.4 MHz, and 8.175 MHz, respectively. All spectra exhibit similar features, namely, they have cascading and frequency-upshifted modes. The fourth figure is the spectrum of excited Langmuir

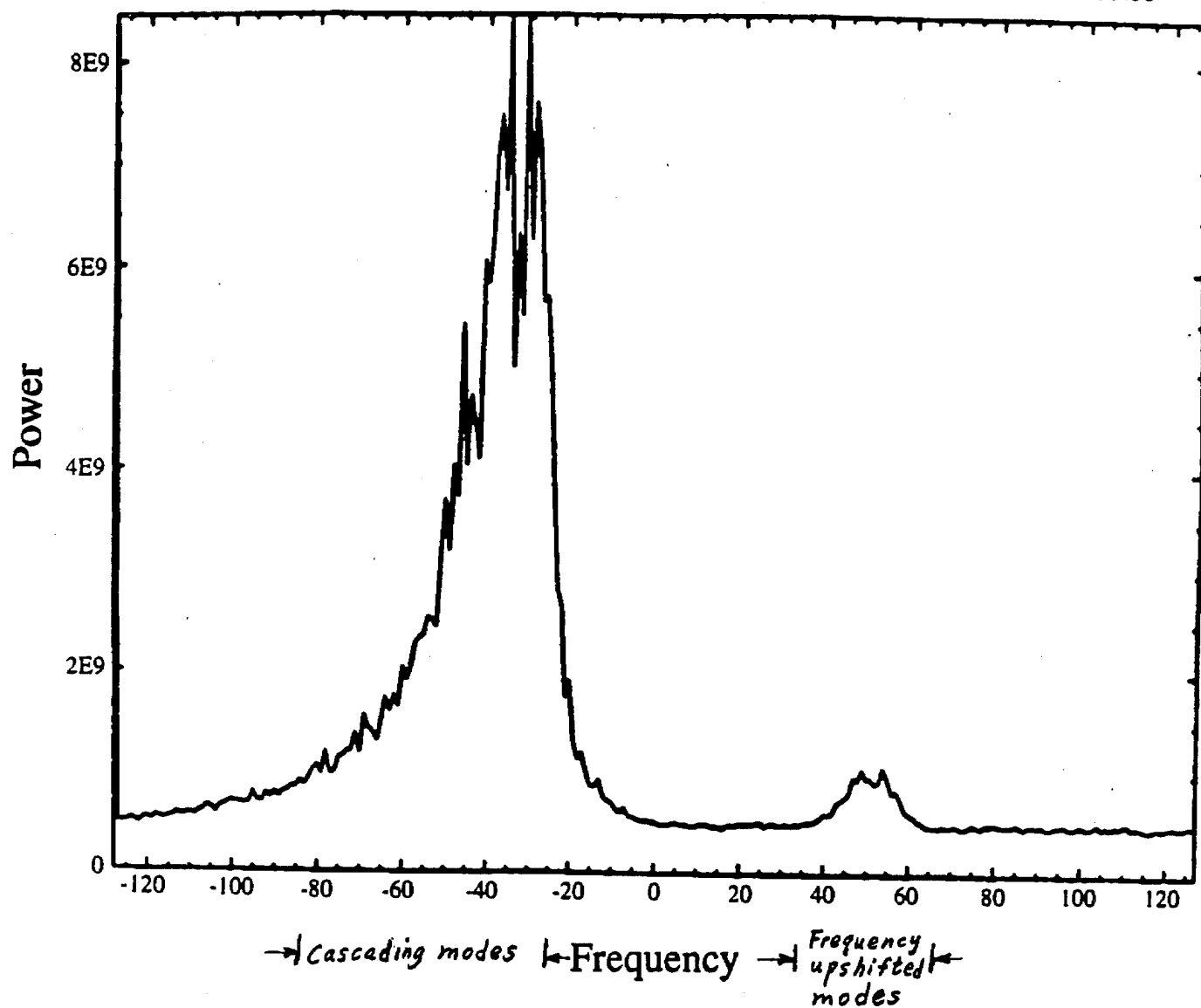
waves recorded in recent VTF experiments. We have successfully reproduced our Arecibo experimental results with VTF.

We have developed a theory to explain the generation of these frequency upshifted plasma modes. These results and other VTF experiments will be reported at the 23rd IEEE International Conference on Plasma Science to be held in Boston this June. Several papers will be submitted for publication in journals subsequently. Reprints of these papers will also be submitted to AFOSR later as supplements to this final report.

*Mr. Chang Ree*

# Arecibo Experiments

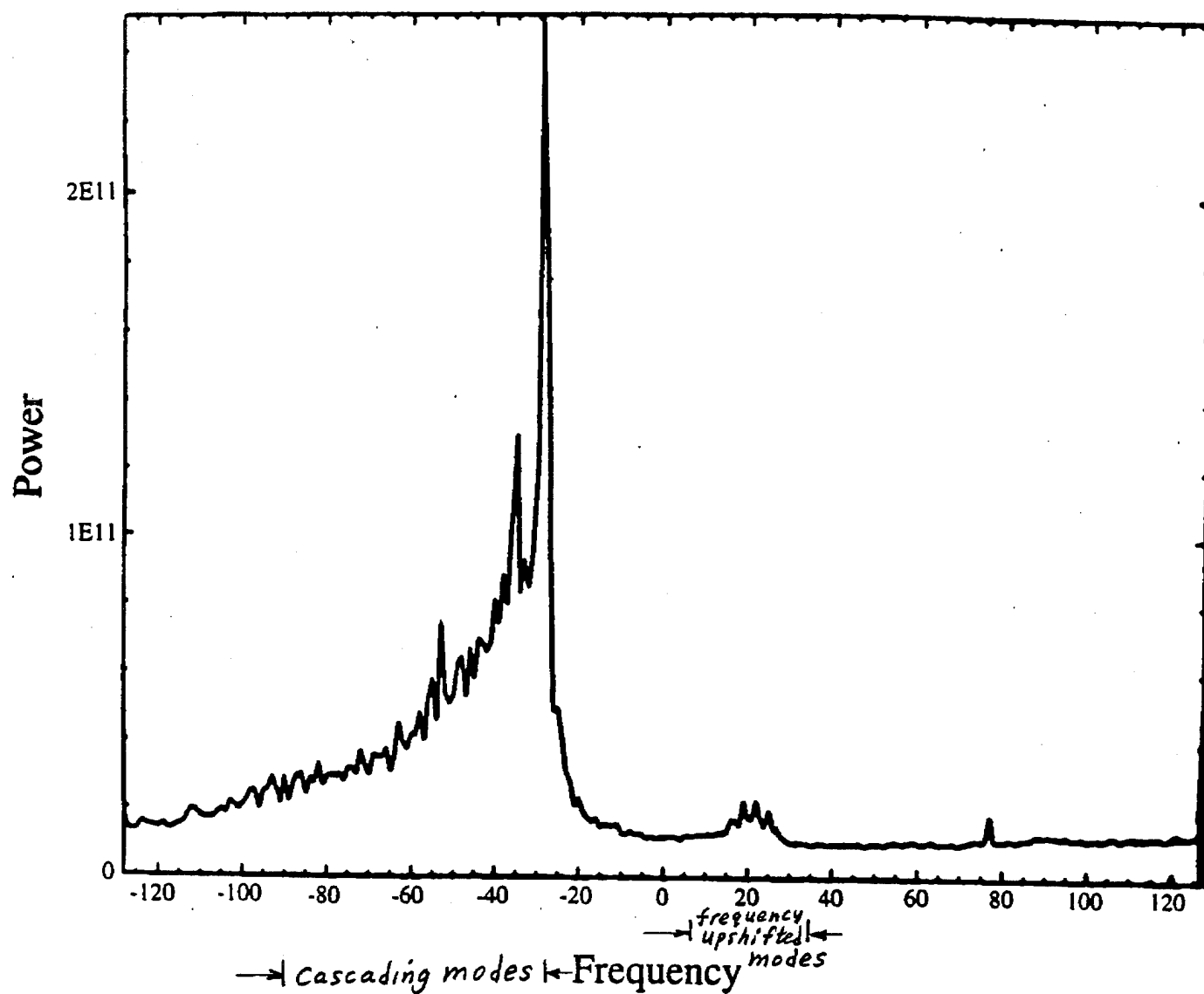
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Radar-Measured Spectra of Langmuir Waves Excited by  
RF Pump Wave at 5.1 MHz (18 July 91)

# Arecibo Experiments

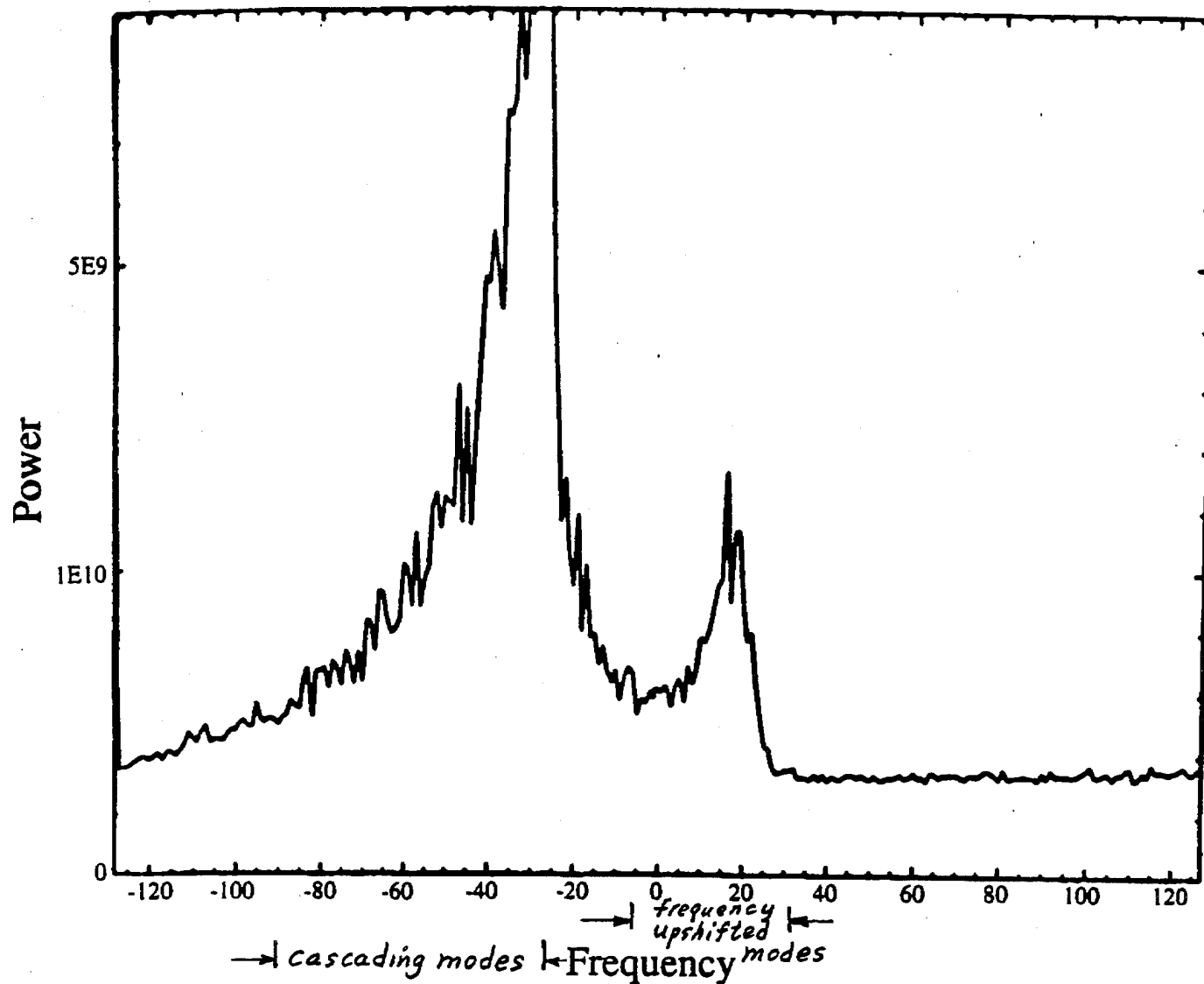
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Radar-Measured Spectra of Langmuir Waves Excited by  
RF Pump Wave at 7.4 MHz (18 July 91)

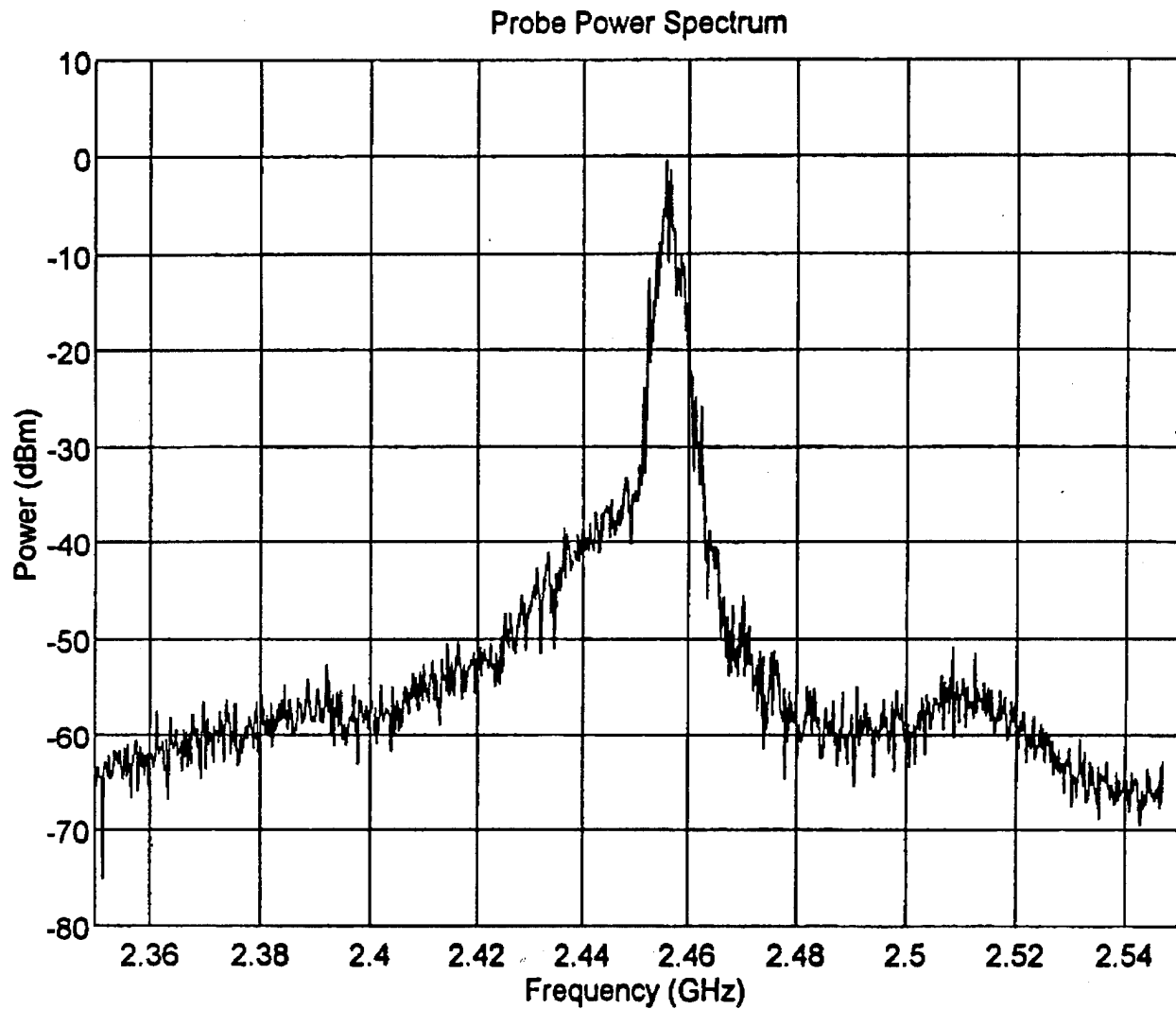
# Arecibo Experiments

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Radar-Measured Spectra of Langmuir Waves Excited by  
RF Pump Wave at 8.175 MHz (18 July 91)

# VTF Experiments (Dec. 21, 1995)



→ cascading modes ←

→ frequency  
upshifted  
modes ←